

THE USE OF MOBILE CLICKER TECHNOLOGY IN FOUNDATIONAL ORGANIC CHEMISTRY FOR ENHANCED STUDENT ENGAGEMENT

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Abstract

Foundational Organic Chemistry is typically taught in the final quarter of the second semester, a period when students often experience reduced concentration and energy levels. Engaging students in this context remains a persistent challenge, particularly given the abstract nature of the content and the high cognitive demands associated with the subject. This study explores the integration of mobile clicker technology as a pedagogical strategy to foster an interactive, inclusive, and responsive learning environment in large classroom setting at a traditional contact university in Pretoria, South Africa. The intervention involved the strategic incorporation of five to six clicker questions within the lecture to stimulate critical thinking, identify learning gaps, and promote collaborative engagement. By using their personal mobile devices, students engage in real-time learning through immediate feedback and lecturer-facilitated discussions aimed at addressing misconceptions. A mixed-method approach was adopted. Quantitative data were obtained from student performance on subtopic-specific questions embedded within lectures, as well as from a comprehensive integrative quiz administered at the conclusion of the topic. Qualitative data were drawn from students' feedback collected through end-of-course teaching evaluations. A pre-test and post-test were also conducted to measure knowledge gained. The findings of this study show that the use of mobile clickers enhanced student engagement, as evidenced by higher participation rates and continued attention during lectures. Students reported improved confidence in navigating complex concepts and valued the immediate feedback. Additionally, the technology fostered a more inclusive learning environment by enabling anonymous participation, thereby supporting contributions from less vocal students. Furthermore, performance on the integrative quiz suggests improved consolidation of knowledge across subtopics. Overall, although mobile clickers have their limitation, the study highlights their value as an effective pedagogical tool in transforming passive learning environments into active, student-centred spaces and recommends their integration in science education.

Keywords: *Mobile clickers, foundational organic chemistry, pedagogical strategy, student engagement, active learning.*

1. Introduction

Academic performance varies significantly among students due to differing abilities, socio-economic backgrounds and circumstances. Unfortunately, not all students get good academic marks at the end of High School and are thus not adequately prepared for university. Access programmes have been designed by many universities across South Africa to accommodate these type of students (Rollnick *et al.*, 2010). Extended Curriculum Programmes (ECPs) have been designed at the study university to grant access to students who have scored lower admission point score (APS) than the minimum required for the mainstream programmes. The aim of the ECPs is to bridge the gap between school and university within a year, allowing the students to strengthen the foundational knowledge, which helps with the transition from secondary to tertiary education.

At the study University, the curriculum structure of the Bachelor of Science (BSc) ECPs, is composed of two fundamental modules, including Language and Study Skills and Academic Information Management (basic computer literacy), and five foundational modules, namely, Biology, Chemistry, Mathematics, Physics and Statistics. The aim of the ECPs is to enhance students' basic knowledge, critical thinking and academic skills. It is expected of students starting their study journey in the ECPs to

3. Objectives

The objective of this study is to examine the extent to which mobile clicker technology enhances student engagement and understanding and the degree to which the used technology supports the attainment of the learning outcomes within a traditional lecture setting.

The study explores how the incorporation of a few multiple-choice and short-answer clicker questions throughout lectures could prompt higher order thinking, hence enhancing students' basic knowledge and academic skills in a foundational Organic Chemistry

4. Methods

A mixed-method approach was adopted to evaluate the intervention comprehensively. Quantitative data were obtained from students' performance on subtopic-specific questions spaced within the lecture slides, as well as from a comprehensive integrative quiz administered at the conclusion of the topic, as shown in Figure 2. Qualitative data were drawn from the university driven students' feedback on the teaching survey (SFTS) collected at the end of the semester. Table 1 contains an excerpt from the 2025 students cohort feedback.

Figure 2. Top: Integrative quiz administered at the conclusion of the topic;
Bottom: Integrative quizzes administered after a specific topic was covered.

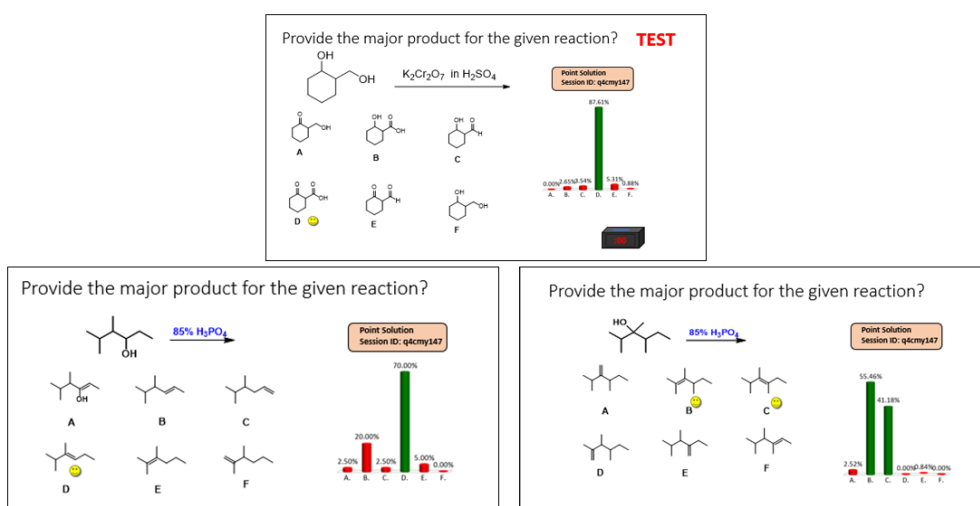


Table 1. An excerpt from the 2025 students' feedback collected at the end of the semester.

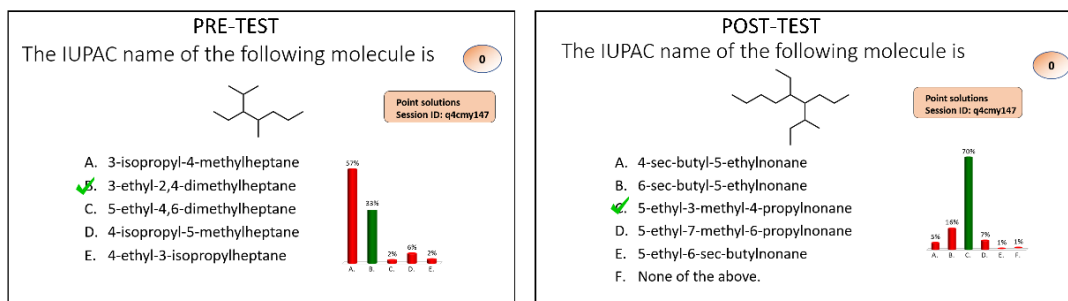
Question: What did you like most in this module?
I really did enjoy doing Organic chemistry with Dr PB. She made the classes interactive and we could really participate in the discussions
The lecturer gave us an opportunity to do clicker questions after explaining the work, which ensured that we were on the same page.
The point solutions activities in class were really helpful
The teaching pace was perfect and I was able to understand most of the work given to me without having to consult with videos on YouTube.
She made students to engage in class which made us to understand more and gave us work problems that prepared us well.
she engages with the students and she made chemistry fun and interesting to learn.
I liked how she would make us engage in class with class activities and clickers. This helped to understand the content much better.
Dr PB prepared lectures that allowed for me to fully engage with and grasp the content being covered. Further studying was therefore simpler as only revision and practice was needed.
The teaching method was beneficial to me and this showed in my marks.
I really liked the way Miss PB interacted with the class. She made classes interesting and interactive.

5. Discussion

The findings of this study showed that the use of mobile clickers in the foundational Organic Chemistry class at the study university had a positive impact on classroom dynamics and students' learning, with high pass rate at the final examination. Research carried out by Ward and co-workers (Ward *et al.*, 2017) showed that the presence of one's smartphone can reduce available cognitive capacity. They also showed that students who kept their phones on their desk while studying, did not perform in their tests. However, the use of mobile clickers in class, and in this study, appears to contradict their findings. By using the mobile phone in a constructive way, changes the perceived view of a source of distraction into a learning tool that enhances learning.

Mobile clickers can be used to quickly identify misconceptions in class, allowing the lecturer to correct them before it becomes deeply rooted in the students' mind. As illustrated in Figure 3 (left), many students did not recognise that the parent name corresponds to the longest chain with the highest number of substituents. This misconception was identified in the pre-test, given to students after initial teaching of nomenclature using the IUPAC rules, and addressed immediately. A similar clicker question was asked in the post-test and the data in Figure 3 (right) showed that actual learning took place.

Figure 3. Left: Pre-test given to students after initial teaching of a topic was done; Right: Post-test given to students after misconception from the pre-test was addressed.



This study also show that the use of mobile clickers enhanced student engagement, as evidenced by high participation rates and sustained attention during lectures. Students who are generally shy do not participate in a traditional classroom setting. Since the PointSolutions Application allows students to respond anonymously, they do not hesitate to participate. There is a noticeable increase in inclusivity and a better overall learning experience. Furthermore, the course achieved a higher pass rate in the final examination (91%), indicating the success of the intervention.

Since this study relies on self-reported data, the findings may be subject to bias. However, the students' feedback collected from the teaching evaluations indicates that the use of mobile clickers in class was perceived as highly beneficial to their learning experience.

One of the main limitations of mobile clickers is the dependence on reliable internet connectivity and mobile device functionality. Unstable Wi-Fi and phone battery depletion can disrupt participation and consequently, reduce the effectiveness of the implemented strategy.

6. Conclusions

This study demonstrates that mobile clickers are an effective instructional tool for the ECPs students. They promote active learning, increase students' engagement and provide immediate feedback during lectures. In foundational Organic Chemistry, their use as a pedagogical tool transforms passive learning environments into active ones, even in periods when students often experience reduced concentration and energy levels. Although mobile clickers have limitations, they can significantly enhance the learning environment when used appropriately. Their integration is therefore recommended in science education.

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